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DRAFT FINAL REPORT

OPERATIONAL REQUIREMENTS SUBCOMMITTEE

PRESENTED TO

PUBLIC SAFETY WIRELESS ADVISORY COMMITTEE

FEDERAL COMMUNICATIONS COMMISSION

NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

January 15, 1996

1.0 EXECUTIVE SUMMARY

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This document constitutes the report of the Operational Requirements Subcommittee, Public Safety Wireless Advisory Committee, regarding operational requirements for the public safety communications community nation-wide through the year 2010. With respect to each functional area of public safety communications, the report catalogs requirements according to the general nature of the information to be communicated. More technical aspects of each requirement are specified in requirement matrices included as an annex to the basic report. In addition, subcommittee observations and recommendations regarding interoperability issues are noted for such use as the Interoperability Subcommittee may deem appropriate.

2.0 OPERATIONAL REQUIREMENTS SUBCOMMITTEE OVERVIEW

2.1 COMMITTEE OBJECTIVES & ORGANIZATION

The Public Safety Wireless Advisory Committee (the "Advisory Committee") was established in response to provisions of Title VI of the Omnibus Budget Reconciliation Act of 1993 directing that the Federal Communications Commission (FCC) and National Telecommunications and Information Agency (NTIA) coordinate more closely with the public safety community in planning for future spectrum needs.

The general mission of the Advisory Committee is to provide advice and recommendations to the Chairman, FCC and the Administrator, NTIA on operational, technical, and spectrum requirements of federal, state, and local public safety entities through the year 2010.

The Advisory Committee also is to advise the FCC and NTIA of opportunities for improved spectrum utilization and efficiency, facilitate negotiated rulemaking at the FCC regarding public safety spectrum, and support development and implementation of plans at NTIA regarding federal public safety spectrum policy.

Based on the assigned mission, the Advisory Committee elected to form five subcommittees. The four subcommittees other than Operational Requirements and their missions are as follows:

The Interoperability Subcommittee is charged with the mission of examining interoperability requirements between and among the various public safety entities, and reducing them to writing. All phases of interoperability, including command and control, are to be examined.

The Technology Subcommittee is charged with the mission of reviewing technology presently implemented, projected technology implementations, and trends in wireless technology. The subcommittee is expected to identify technologies related to each operational need and determine bandwidth required to meet that need. The Technology Subcommittee also is expected to identify spectrum limits for each bandwidth identified.

The Spectrum Subcommittee has the mission of taking the bandwidth and spectrum placement recommendations and recommending a spectrum allocation plan. The plan is expected to include current spectrum assignments and recommendations with regard to future allocations. A timetable is to be developed by the subcommittee based on recommendations received from the Transition Subcommittee.

The Transition Subcommittee has the mission to consider how to implement the new technologies and services in a timely, rational manner. Issues to be considered by this subcommittee include funding methods, migration plans, and time tables.

2.2 CHARTER OF THE OPERATIONAL REQUIREMENTS SUBCOMMITTEE

The general mission of the Operational Requirements Subcommittee (the "Subcommittee") is to enumerate the communication needs of the public safety community without regard to specific technology or spectrum. The needs are to be classified as to the type of service (e.g., real-time, full-motion video) and quantity of service (number of channels, e.g., two full-time video channels in every city, one for EMS use and one to be shared between fire and police). Each need additionally is to be prioritized as to necessity for proper functioning of the public safety community.

2.3 SCOPE OF THE SUBCOMMITTEE REPORT

This report of the Subcommittee is intended to provide a snapshot of operational capabilities that must be considered in the overall planning process. The Subcommittee also has examined operational requirements that are unmet or suffer from reliability, quality, or coverage deficiencies. This report of the Subcommittee will be forwarded to the Technology and Interoperability Subcommittees. Requirements for interoperability identified by this Subcommittee will be forwarded to the Interoperability Subcommittee for consideration.

Many public safety entities and organizations provided comment regarding the issues encompassed in the responsibilities of the Subcommittee. In many cases the comments received included topics outside the scope of the Subcommittee charter. The following limitations were observed in preparing this report.

Several comments included specific suggestions regarding the particular frequency range appropriate for particular requirements. The Subcommittee position is that issues of spectrum use fall within the purview of the Spectrum Requirements Subcommittee. No recommendations or commentary are included in this report regarding appropriate frequencies.

Several comments included specific suggestions regarding the number of channels that should be devoted to particular applications in the commenting agency's particular geographic area of responsibility. The Subcommittee position is that issues of spectrum allocation in particular jurisdictions also fall within the purview of the Spectrum Requirements Subcommittee. The Subcommittee has made no attempt to state operational requirements for quantities of channels that must be apportioned to any particular jurisdiction. The Subcommittee has, however, in the course of its work attempted to identify the basic complement of communications support that must be maintained by any jurisdiction that provides the various public safety services involved in this report, along with priorities appropriate to each type of support.

A few comments were received suggesting that the Subcommittee study and include in its report a catalog of specifications that equipment, for example portable radios, should meet in order to be suitable for public safety use. The Subcommittee considered performing such as study incident to its work, but concluded this topic was not germane to the basic mission of the Subcommittee and the Advisory Committee, which is oriented on spectrum.

3.0 SUBCOMMITTEE ORGANIZATION

3.1 DEFINITION OF PUBLIC SAFETY

At the first meetings of the various subcommittees conducted in Washington, D.C. on September 29, 1995, considerable discussion occurred regarding the definition of "public safety" for purposes of the Advisory Committee. For purposes of this report, the Operational Requirements Subcommittee elected to use a very expansive definition, with the

understanding that the Advisory Committee might at some future time adopt a less expansive definition for its purposes. The Subcomittee's approach was based on two observations. First, the Subcommittee recognized that although a particular industry or constituency's primary business might not fall within a classic public safety definition, aspects of its operations could involve or impact matters of public safety. Second, the Subcommittee recognized that by providing an expansive catalog of requirements from the various constituencies, other subcommittees and ultimately the Advisory Committee would benefit from a broad perspective in determining precisely what requirements should be accommodated when spectrum and other issues are addressed.

3.2 WORKING GROUPS

The Subcommittee elected to form seven working groups. The working group designations, along with their general areas of focus, are described as follows.

1. **Infrastructure.** The mission of the Infrastructure working group is to catalog operational requirements for infrastructure communications needed to support other indentified public safety communications requirements at federal, state and local levels.

2. **Law Enforcement.** The mission of the Law Enforcement working group is to catalog operational requirements for law enforcement organizations at federal, state and local levels.

3. **Emergency Medical Services and Fire Services.** The mission of the Emergency Medical Services (EMS) and Fire Services working group is to catalog operational requirements for fire and EMS organizations at federal, state and local levels.

4. **Emergency Management and Disaster Services.** The mission of the Emergency Management and Disaster Services (EMD) working group is to catalog operational requirements for emergency management and disaster services at the federal, state and local levels.

5. **Public Service.** The mission of the Public Service working group is to catalog operational requirements for public service entities at federal, state and local levels.

6. **Other.** The mission of the "Other" working group is to catalog operational requirements for Highway Maintenance, Forestry, Local Government, and Mass Transit organizations at federal, state and local levels.

7. **Matrix Refinement and Report.** The mission of the Matrix Refinement and Report working group initially was development of a common matrix of data required to describe each operational requirement. The matrix developed by the Subcommittee is included with this report as Annex A. This working group also was responsible for preparation of this report.

3.3 COMMITTEE DELIBERATIONS

An organizational meeting of the Subcommittee was conducted September 29, 1995 in Washington, D.C. At that meeting, discussion was conducted and consensus reached regarding the subcommittee mission and the public safety functional areas to be examined. Consensus also was formed regarding the working groups necessary to accomplish subcommittee purposes. An initial discussion was conducted regarding the composition of a matrix to be used to catalog each operational requirement identified by the working groups. Following the September meeting, work was completed on a draft version of the matrix.

The subcommittee met again on October 26, 1995 at Camp Dodge, outside Des Moines, Iowa. The principal matter on the agenda was review of the draft matrix. Considerable discussion ensued, resulting in refinement of the matrix for use by the various working groups. Following the October meeting, the matrix was revised to reflect subcommittee deliberations and distributed to working group leaders. Working group leaders began formulating their proposals of operational requirements in each of the functional areas represented by the groups.

A special meeting was conducted in San Bernerdino, California on November 17, 1995. Federal budget issues precluded attendance by a Designated Federal Officer, so the meeting was conducted as an informal review of subcommittee activities and progress. Considerable, wide-ranging discussion occurred. Attendance was heavily weighted toward users, suggesting that additional meetings in other regions of the United States would benefit the various subcommittees.

A regular meeting of the Subcommittee was conducted in Washington, D.C. on December 13, 1995. Interim reports were presented by the various working group chairs regarding their progress to date. A status report regarding the Subcommittee's activities was presented to the Advisory Committee at its regular meeting conducted December 15, 1995. Following the December 13th meeting, working group leaders continued work on their narratives of operational requirements. Their work was provided the Matrix Refinement & Report working group, which incorporated it in this report.

A regular meeting of the Subcommittee was conducted in Berkeley, California on January 10, 1996. Copies of the draft report of the Subcommittee were made available to meeting attendees, and comments regarding its comment were received. Following the meeting, revisions were made to the report to reflect the consensus of meeting attendees and those who commented by other means.

4.0 WORKING GROUP REPORTS

This section of the report of the Subcommittee is a discussion of the operational requirements identified by each working group. In each case, the working group report is intended to present each operational requirement from the user point of view, categorized by the nature of the information to be communicated. Specific, more technical aspects of each requirement identified are reflected in the matrices of operational requirements included at Annex B.

4.1 INFRASTRUCTURE

4.1.1 **Mission.** The mission of the Infrastructure working group is to catalog operational requirements for infrastructure communications needed to support other indentified public safety communication requirements at federal, state and local levels.

4.1.2 **Introduction.**

4.1.3 **Voice Requirements.**

4.1.4 **Data Requirements.**

4.1.5 **Video Requirements.**

4.2 LAW ENFORCEMENT

4.2.1 **Mission.** The mission of the Law Enforcement working group is to catalog operational requirements for law enforcement organizations at the federal, state and local levels.

4.2.2 **Introduction.** Wireless communications support is crucial to assure quality law enforcement services and create the safest possible working environment for law enforcement personnel The following discussion is the product of discussion and correspondence with law enforcement officials from various locations in the United States. The emphasis of the working group has been on identification of present and future operational needs, dependent on wireless communication, without regard to cost or the current availability of technology. Needs are categorized into the three basics categories of voice, data and video.

4.2.3 **Voice Requirements**. In general, voice communications for law enforcement. must include coverage from portable to portable unit, through a system, radio to radio, or some other technology. Officers must be able to speak with each other via the portable radio if they can see each other. Likewise, officers from one end of a jurisdiction must be able to talk to officers in another part of the jurisdiction on a jurisdiction-wide channel. Voice coverage from portable radios must include the ability to communicate from within buildings with a high degree of reliability.

The law enforcement voice communications system must have the ability to be expanded to support a relatively unlimited number of users quickly, i.e., 3-5 hours. Normal day to day police operations may not require large volume radio capacity. However, when a man-made or natural disaster strikes, the system must have the ability to expand to meet demand.

Voice communications for law enforcement must feature multiple levels of encryption. Routine operational traffic will require one level of encryption. Other operations such as executive protection, high level drug and organized crime unit security and federal security needs often will warrant a higher level of transmission security. Some routine traffic may be "unencrypted", but devices must be able to monitor both encrypted and non-encrypted messages simultaneously.

Voice Dispatch. Voice communications routinely occur between officers in the field and central dispatch points. Information conveyed commonly includes both operational instructions and information. The law enforcement voice communications system must support routine dispatch communications.

Officer to Officer Voice Communications. Voice communications routinely occur between one officer in the field and one or more other officers in the field. Information conveyed commonly includes both operational instructions, administration information, and general coordination. The law enforcement voice communications system must provide support for routine voice communications between officers working within a particular jurisdiction.

Air to Ground Voice Communications. Aviation units are a common part of most major law enforcement agencies. Aviation units perform traffic enforcement missions, routine patrol and detection, search and tracking capabilities, and provide airborne command and control support. Because aviation units commonly work with a separate or distinct group of ground units for a particular operation or event, the law enforcement voice communications system must provide support for routine voice communications between aviation units and officers and commanders on the ground who are working

with one or more aircraft. The same frequency could support air to air communications between aircraft of the employing jurisdiction.

Special Operations Communications. Special investigations, task forces and other discrete activities are a commonplace aspect of today's law enforcement community. A voice communcations capability that is separate from normal operations voice traffic generally is required to support each special operation. These channels must have an extremely high security level of encryption capability available.

4.2.4 **Video Requirements.** Multiple agencies may need to be able to monitor another agency's video transmissions, but the ability to access public safety video must be based on a "need to know" or incident management control basis.

Incident Video. Some incidents like high risk surveillance, prison riots, high risk drug transactions, and emergencies require real-time video. While these incidents may be infrequent in some areas, others will have a more frequent demand for real-time video. The capability must exist for both point-to-point and broadcast use of the video. For example, full motion video must be transportable from the incident scene to an incident command post, and also to a remotely located emergency operations center. Prison riots, chemical/nuclear incidents, etc., may require monitoring of the incident from more than one location.

Aerial Surveillance Video. Many law enforcement agencies operate routine surveillance of traffic, crime in progress situations and other events from airborne platforms. Full motion video transmissions from these airborne platforms to command and control locations and supervisors on the ground is required.

Robotics Video. Hazardous material and explosive response frequently benefits from use of robotic devices. Full motion video transmissions from the robotic device to a locally-located control site is required to support such robotics activities.

Surveillance and Monitoring. Law enforcement requires the ability to transmit video snap shots at the rate of one frame each 5 seconds, for surveillance and monitoring purposes. For example, person and building surveillances, low risk drug transactions, and building security would be adequately served by this quality of video transmission.

Officer Safety and Operational Video Transmission (Two Way). Many patrol cars used by law enforcement agencies now are equipped with mobile video cameras. Video recorded by these cameras provides evidence usable in criminal trials, and documents officer actions in the event professional standards concerns are voiced. The ability to transmit full motion video from mobile video cameras directly to dispatch and other command and control installations is required on demand. Although constant transmission of this data from each individual officer or mobile unit is not required, the ability to monitor video from a unit may be needed on an episodic basis in the event of officer assistance situations and other high risk events, or operations of high command interest. In addition, the system must support retransmission of full motion video to mobile and remote locations, where command and control personnel and other mobile officers can monitor, perform decision-making and provide assistance based on the video transmission.

Still-Photographs. Law enforcement requires the ability to transmit still

photographs on demand to other locations. For example, an officer in the field should be able to transmit a digital image of the violator in custody to a remote location upon demand.

4.2.5 **Data Requirements**. The basic law enforcement requirement for data is immediate, clear transfer and display of text and graphical information for all law enforcement personnel, in support of both routine and emergency operations.

Mobile Data Computer/Terminal Applications. A need exists for real-time communications support of wireless mobile and portable computer systems capable of transmitting and receiving routine data queries and responses, electronic mail, location and other graphics including fingerprints and mug shots, along with incident-specific data and intelligence.

Geographic Position and Automatic Location Data. Law enforcement requires the ability to transmit location data, determined by geopgraphic position technology or other means, automatically or on demand to other locations. Examples of this need include constant updating of vehicle positions for dispatch and officer safety purposes, constant updating of individual officer location for safety purposes when the officer is outside his or her vehicle, and the ability to trigger position transmitting devices on lost or stolen equipment items.

Emergency Signals. Officers who need emergency assistance must be able to activate an alarm that sends an automatic distress notice to a central monitoring point and other officers in the field.

Transmission of Reports. This system should accommodate transmission of forms and reports to central sites from mobile and remote locations. This capability will be used by law enforcement to transmit accident reports, arrest reports, citations and incident reports to central locations in long data streams of up to several seconds. This capability will reduce paper transactions, increase officer field time, and speed transmission of vital information to command and administrative staff.

Electronic Messaging. Law enforcement officers require the ability to input messages into a data transmission device for transmission to single or multiple agencies, including other officers and other public safety providers.

Remote Device Monitoring. Law enforcement requires the abiity to monitor remote device indicators via data transmission. For example, the ability to monitor air quality standards at chemical and nuclear incidents is needed on a real-time basis to help establish evacuation plans. Data transmission capabilities must support transmission of wind speed and direction, temperature, and a time and date stamp. The data bank of remote device transmissions must be accessible by remote computer or terminal for incident tracking and decision-support by officers in the field including on-site personnel.

4.3 FIRE SERVICE AND EMERGENCY MEDICAL SERVICES

4.3.1 **Mission.** The mission of the Emergency Medical Services (EMS) and Fire Services working group is to catalog operational requirements for fire and EMS organizations at the federal, state and local levels.

4.3.2 **Introduction.** Wireless communications support is crucial to assure

quality life and property protection, and to create the safest possible working environment for fire and EMS personnel. The following discussion is the product of discussion and correspondence with fire and EMS officials from various locations in the United States. The emphasis of the working group has been on identification of present and future operational needs, dependent on wireless communication, without regard to cost or the current availability of technology. Needs are categorized into three basics genres of wireless communication: voice, data and video.

4.3.3 **Voice Requirements**. The basic requirement for voice is immediate, clear voice communications for all fire and EMS personnel upon all demands, major and minor, created by natural, man-made and medical emergencies. Adequate voice lines of communication must be provided for safe, efficient operations at all incidents. Lines of communication must be immediately available and expandable to accommodate major disasters.

Tactical Voice. Tactical voice communications requirements exist at the actual situation or suppression level of an incident. One tactical voice network is required for each strike or response team. The number of strike or response teams will vary with the size and nature of the incident.

Command Voice. Command and control voice communications requirements exist at each successive level of command above tactical level. One command voice network generally will be required for each leader in the chain of command, upon which all leaders immediately subordinate will operate.

4.3.4 **Data Requirements.** The basic requirement for data is immediate, clear multiplex wireless transfer and display of data (text and graphical) for all fire and EMS personnel upon all demands, major and minor, created by natural, man-made and medical emergencies.

Mobile Data Computer/Terminal Applications. A need exists for communications support of wireless mobile and portable computer systems capable of transmitting and receiving incident-specific data and intelligence. Support for this system should accommodate transmission of text such as electronic mail, multi-layered geographic information data (GIS), as well as real time data such as geographic position information and incident intelligence received from remote sensors or directly keyed.

Automatic Location Information. A need exists for automatic communication of location information generated for response vehicles and personnel operating away from their vehicles.

Biomedical Information. A need exists for wireless transfer of biomedical data from EMS units to hospital base stations, and from hospital base stations to EMS units.

Robotics Support. A need exists for transmission of data to and from robotics devices used in extremely hazardous situations.

4.3.5 **Video Requirements.** The basic requirement for video is immediate, clear wireless transfer of video for all fire and EMS personnel upon demand, major and minor, created by natural, man-made and medical emergencies. Video capture and display systems must be capable of transmitting and receiving incident-specific imagery, and should accommodate video from all available sources including privately owned and agency controlled. For example, automatic aid agreements with commercial broadcast agencies would

often provide quality video imagery of incident scenes for command personnel, either directly or through retransmission.

Incident Video. Full motion video must be transmitted from incident scenes to the incident command post, and also to remotely located emergency operations centers.

Emergency Medical Treatment Support. Provision of emergency medical services can be enhanced through transmission of full motion video from incident locations and evacuation vehicles and aircraft to the treating trauma center. Trauma center staff can view the video, assess vital sign data transmissions, and provide valuable treatment instruction to EMS personnel attending the patient.

Aerial Observation Video. Transmission of full motion video is required from airborne observation platforms to command personnel and incident command posts.

Robotics Video. Incident responses frequently would benefit from full motion video transmissions from robotic devices to local control sites to support robotics activities and incident command activities.

4.4 EMERGENCY MANAGEMENT AND DISASTER SERVICES

4.4.1 **Mission.** The mission of the Emergency Management and Disaster Services (EMD) working groups is to catalog operational requirements for emergency management and disaster services at the federal, state and local levels.

4.4.2 **Introduction.** Communications system requirements for emergency management and disaster services are characterized by very low usage patterns during routine operations and extremely high usage patterns during a major event. Thus, radio systems designed and used by emergency management agencies appear to be virtually unused on a day-to-day basis, yet when a major event occurs, these same systems are inadequate for meeting the need to communicate. Although individual communications systems performed properly, incident needs still were not met due to interoperability issues in New York at the World Trade Center, in Miami following Hurricane Andrew, in Oklahoma City, in Los Angeles during the Rodney King riots and following the Northridge Earthquake, in San Francisco following the Loma Prieta Earthquake, and countless other times.

We should not look at large-scale events as being an anomaly. True, major earthquakes do not occur that often. Nor do hurricanes or floods. Taken all together though, they occur more often than we would like to think. Furthermore, few years pass without a major forest/wildland fire being battled by one thousand or more firefighters from hundreds of fire agencies. The reality is, large-scale events happen every year at unpredictable locations and at unpredictable times. Public safety agencies must be prepared to respond to these events when they occur and they need effective communications to aid in their response. While the unpredictability of these events makes it impractical to have adequate wireless communications facilities in place, we can identify and protect a block of frequencies from which such facilities can be rapidly developed. Portable repeaters and programmable multi-channel radios have provided the needed technology. It is time for frequency planners to provide the spectrum.

4.4.3 **Voice Requirements.**

Internal Operations. Emergency management agencies require at least one voice channel (encryption capable) for command/control of their own personnel for both routine operations and for large-scale emergencies and disasters.

Mutual Aid. Large-scale emergencies and disasters place a particular burden upon the operation of public safety communications systems. Many of these events exceed the capability of local agencies and they turn to outside agencies to provide mutual aid. While the outside agencies provide the men/equipment needed to handle the situation, they also produce an increased demand for communications. A major wildland fire, for instance, may involve over one thousand firefighters from over 100 different agencies.

Currently, one channel has been designated nationwide for law enforcement use (155.475 MHz), four channels have been designated nationwide for fire use (45.88 MHz, 154.265 MHz, 154.280 MHz, and 154.295 MHz), and five channels have been designated nationwide for public safety use (866.0125 MHz, 866.5125 MHz, 867.0125 MHz, 867.5125 MHz, and 868.0125 MHz). Some state and local agencies have set aside additional channels to improve the situation, but there remains a dearth of channels to handle a large-scale event. This becomes a particular problem in the major metropolitan areas where all other public safety are already in use for normal operations.

A dedicated block of mutual aid channels should be available nationwide for use by any public safety agency. Use of the channels should be subject to a system of priorities such as the following:

Priority 1
Disaster and extreme emergency operations for mutual aid and interagency communications

Priority 2
Emergency or urgent operations involving imminent danger to the safety of life or property

Priority 3
Special event control activities, generally of a pre-planned nature, and generally involving joint participation of two or more agencies

Priority 4
Single agency secondary communications

It may be desirable to restrict Priority 3 and 4 communications to a particular sub-set of the set aside mutual aid channels, with different channels available for police, fire, EMS, and other public safety users. While Priority 4 communications do not seem to satisfy the mutual aid requirement, they provide an incentive to public safety agencies to implement the mutual aid capability in their mobile/portable radios.

Inter-Agency Communications. Many public safety emergencies, particularly large-scale emergencies and disasters, require a response from multiple agencies. The response from these agencies needs to be coordinated and controlled. Currently, much of this coordination occurs over the public switched telephone network (POTS). History has shown, however, that the POTS network is disrupted during a large-scale emergency or disaster due to damage or overload. During a major event, at least one voice and one data

channel are needed between each of the following points:

- Federal Emergency Management Agency (FEMA) and State Emergency Services Agency
- State Emergency Services Agency and Event Command Center
- Event Command Center and County Government Command Center (provide 10 sets of channels to allow for multiple counties to be involved in the event. For instance, the Loma Prieta Earthquake affected Monterey, Santa Cruz, San Benito, Santa Clara, San Mateo, San Francisco, Alameda, and Contra Costa counties.)
- County Government Command Center and Major City Command Center (provide channels to allow for multiple counties and cities to establish communications)

The voice channel should be capable of encryption.

Long-Range Communications. Public safety response to large-scale emergencies and disasters usually requires the assistance of agencies from outside the "event area." One characteristic of such events, however, is disruption of the normal long-range communication networks through which such assistance might be requested. The public telephone network, for instance, may be unusable due to actual damage resulting from the event or due to system overload. Thus, there is a requirement for long-range communications which either are sufficiently robust as to withstand the initial event or are rapidly deployable.

High-frequency single-sideband (HF-SSB) communications systems are one method by which public safety agencies currently satisfy this requirement. These systems have been established under Section 90.264 of the Federal Communications Commission Rules and Regulations. They operate in the 2-10 MHz portion of the radio spectrum and offer communications over distances of several hundred miles.

> **RECOMMENDATION:** Maintain the current frequency allocations but eliminate the inter-state restrictions on the points of communications. Federal Communications Commission licensing practices on these channels currently restrict use of certain channels to "inter-state use only" and, in some cases, to communications with specified other states. These restrictions fail to recognize the usefulness of HF systems for communications within a large state. The distance between Los Angeles and Sacramento, CA, for instance, is nearly 400 miles.
>
> **RECOMMENDATION:** Eliminate "day/night" restrictions on the use of certain frequencies. The choice of frequency is dependent on many different factors, including not only the time-of-day but also the distance between communication points and the propagation conditions. The determination of which frequency is used should be based upon that frequency which provides the needed communications, not the position of the sun.

Satellite based communications are another method by which public safety agencies currently satisfy the requirement. Systems utilizing very-small aperture (VSAT) technology are capable of providing both voice and data

services over virtually any distance. Although intended for maritime use, the INMARSAT system also provides a potentially useful capability for voice and data communications.

Urban Search & Rescue. Several Urban Search and Rescue (USART) teams have been established across the country. These teams have proven their value during the Northridge Earthquake and the Oklahoma City bombing through their ability to conduct difficult rescue operations in downed buildings. By their very nature, USART operations are high-risk events where effective communications may affect personnel safety. Currently, the communications for these teams is based upon radio equipment and frequencies used in their home area and are subject to causing/receiving interference with other public safety agencies within the area of the event.

> **RECOMMENDATION:** Set aside channels on a nation-wide basis for specific use by USART personnel. As a minimum, the following is needed:
>
> **1 ea repeater pair**
> National USART command channel for communications between the USART team leaders and the event command center.
>
> **3 ea repeater pair**
> Team command channel for communications between USART team leaders and members of their team. This is based upon three teams being "on-duty" at any given time. Specific channels would be assigned to each team on a "per-event" basis.
>
> **10 ea simplex**
> On-scene tactical communications for USART team members. This is based upon different groups working different parts of a building in close proximity, each needing a "clear" channel for safety reasons.
>
> **2 ea simplex**
> Robotics control channels. This is based upon two different robotics operations in close proximity.
>
> **2 ea simplex**
> Robotics video/audio channels. This is based upon two different robotics operations in close proximity.

Non-Public Safety Agencies. Many non-public safety agencies provide valuable services during a disaster or major emergency. These agencies include the American Red Cross, the Salvation Army, and the Civil Air Patrol. Public officials managing the disaster/event need voice and data communications with these agencies to exchange information regarding the care and feeding of victims.

> **RECOMMENDATION:** Establish 10 nationwide voice/data channels for communications between event command centers and these agencies.

News Media & Emergency Broadcast. Public officials managing any event have an obligation to inform the public about the emergency. The Emergency

Broadcast System and the news media provide a valuable means by which information can be distributed to the public-at-large. A weak-link in the system, however, is the link between the public official and the media. Currently, these messages are passed to the media either at a news conference or via telephone calls.

The State of California has implemented a system called the Emergency Digital Information System (EDIS) which utilizes land-mobile radio channels to pass digital messages directly to commercial broadcasters. These messages are formatted such that radio/TV announcers can "rip and read" as if the message were a teletype message and TV broadcasters can scroll the message across the screen. Messages can be generated by any public official having access to the system with the Governor's Office of Emergency Services controlling use of the system.

> **RECOMMENDATION:** Establish a nationwide channel for EDIS-type messages from appropriate public officials to broadcasters.

RACES. Radio Amateur Civil Emergency Service (RACES) operates on radio amateur frequencies by authority of the Federal Communications Commission in support of public safety. RACES can augment existing systems, substitute for damaged and inoperable systems, and establish communications links with otherwise inaccessible areas. RACES uses HF, VHF, and UHF equipment operating on packet (data), voice, CW Morse code, radio-teletype, and television (ATV). While not a public safety spectrum requirement, the services provided through RACES should be continued and protected.

4.4.5 **Data Requirements.**

Global Positioning. While not a spectrum requirement, access to the Global Positioning System (GPS) is a valuable tool in a disaster. Following an earthquake, flood, hurricane, or other disaster it is not uncommon for normal landmarks to have disappeared. Buildings are destroyed, streets are covered, and road signs are missing. Emergency management personnel need a means by which they can map the event so that they can better understand where the problems lie and dispatch personnel to deal with situations appropriately.

4.5 PUBLIC SERVICE

4.5.1 **Mission.** The mission of the Public Service working group is to catalog operational requirements for public service entities at the federal, state and local levels.

4.5.2 **Introduction.** One classification of public safety wireless communication users are those entities that rely on wireless systems to prevent catastrophes that endanger life and property. Entities such as transportation companies and public utilities operate communications networks that interface with classically defined local, state and federal public safety entities on a daily basis. One primary purpose of these networks is to minimize risk to the public. These networks also aid other public safety providers in performing their missions when a catastrophe does occur. This section of the report identifieds many of the current communications requirements of this class of wireless communication users.

4.5.3 **Voice Requirements.**

Dispatcher to Crews. This is typical communications path between dispatchers and field personnel. The call types are typically business oriented with emphasis on operating the business in a safe and efficient manner.

Crew to Crew. This function relates to the typical communications between field users. These communications are used for the coordination of daily activities to maximize the safety and efficiency of operations.

Emergency Call. This function is typically initiated from a field user to a dispatcher. As the name implies, the call type is that of an emergency where loss of life or property is emanate or has already taken place.

"Talk Around". In many operations between field users, routing a call through the network or a repeater is not desirable for reasons such as access delay or being out of range of the system. A talk around mode is necessary so that the field users can communicate with each other, within the range of their mobiles and portables, without the assistance of a network or repeater.

Interconnect. In nearly all field activities, users have a need to communicate with people by way of land line telephones. Telephone interconnect is a necessary option for many of the present day radio systems.

4.5.4 **Data Requirements.**

End of Train Control. This is a system which provides a data communications link between the end of the train and the train crew. With this link, the engineer of the train can determine if the end of the train is in motion, what the break line pressure is and whether the end of train flashing marker is illuminated. The engineer can also apply the brakes from the end of the train by remotely releasing the brake pipe pressure. All functions associated with this device relate to safer handling of the train.

Positive Train Control. This is a data system which utilizes a computer on board the locomotive which is used to minimize collisions between trains. The locomotive computer obtains movement authorities from a host computer and calculates when it needs to stop the train based on the speed and weight of the train. If the limits of authority are going to be violated, the computer will stop the train automatically.

Track Warrants. Track warrants are the movement authorities which are used by the train engineer. Track warrants are typically read to the engineer over the radio system by the dispatcher. There are plans in place to provide a data link between the dispatcher and the train engineer to reduce errors in copying the track warrant.

Crossing Safety. Crossing accidents are of great concern to the railroad industry. Systems are being investigated which will provide a notification to Public Safety vehicles and school busses that a train is approaching a specific crossing which may affect them. This will provide added warning of approaching trains.

In addition to the warning systems, data links are being investigated which will be used to report any malfunctions with the railroad crossing. Defects such as inoperative or broken crossing arms, vandalism, as well as power failures can be reported to maintenance personnel.

Cab Signals. Cab signals provide a visual warning to the train crew as to the

status of the track immediately ahead of them. As an example, if the track is occupied, the signals to the train crew will show red. If the track is clear, the signals will show green. This form of alerting the crew is very helpful in train control and collision avoidance.

Train Line. The current form of braking for trains is through a pressurized brake line. If the air pressure is reduced, the brakes of the cars as well as the locomotives are applied. Often times, the air pressure does not respond as quickly or as fully as needed by the train engineer, creating a problem with train handling.

A train line is being developed which will provide a communications path thorough the train. One of the functions of the train line will be to provide electronic breaking information to each car, eliminating the need for the air line.

Consist Telemetry. An extension of the train line function listed above is a communications system which handles information for all items being transported. Typical information includes the condition of the cargo in terms of over temperature or rough riding which would be helpful when transporting hazardous materials. Other uses would be to provide additional alarming to the train crew for purposes of theft and vandalism control.

System Protection Telemetry. The power utilities rely on communication links to assist in monitoring and control of power distribution systems. Very large and fast acting circuit breakers obtain information about short circuits and disconnect the power source in order to minimize risk of life and damage to property. These communication links are also utilized in the substations which are used to reduce the voltage of the transmission systems for distribution to households.

Load Shed Telemetry. On a smaller scale from system protection as described above, load shed telemetry is used to control the amount of power used by consumers. A data communication system is used to remotely control air conditioners and electric water heaters in an attempt to minimize overloading of the transmission and distribution systems.

Defect Detector Comm. Link. Defect detector communication is typically one way and is composed of a low power transmitter located at the detector sites. If a defect is detected, a synthesized voice radio transmission is sent. This will alert the crew of the train in the area of the detector before injury and/or damage occurs.

The following is a list of typical defect detectors:

1. Hot box/journal.
2. Dragging equipment.
3. High and wide equipment.
4. Rock slide/mud slide.
5. Flood.

Security System Monitoring. Property and equipment need to be monitored via security systems. Most of the applications require some form of wireless

communications to establish the link.

Location Systems. For train control, location systems such as GPS are needed to obtain the location of the train in relation to limits of movement authority as well as other trains. Unfortunately, standard GPS does not have the required accuracy which can be accomplished by Differential Global Positioning Systems (DGPS). One of the requirements for the DGPS system is that the users must have a secondary data link which is independent of the satellite link.

Inventory Access. Both railroad and utility industries have situations where having access to a store department record would facilitate derailment clean up or storm restoration respectively. To accomplish this, a data link between the field user and a host computer is necessary in order to determine and acquire needed materials.

4.5.5 **Video Requirements.**

Video Surveillance. As an extension of the security system monitoring item above, video surveillance provides much more information in specific situations than typical alarms can provide. In may cases, the video surveillance would be most effective if it was available through a wireless means.

4.6 OTHER PUBLIC SAFETY ENTITIES

4.6.1 **Mission.** The mission of the "Other" working groups is to catalog operational requirements for Highway Maintenance, Forestry, Local Government, and Mass Transit organizations at the federal, state and local levels.

4.6.2 **Introduction**. First responders such as police, fire, and emergency medical services are groups which, without doubt, are traditionally accepted by all as public safety services. There are other services not generally or immediately accepted as public safety entities by the general public or other public safety providers. The Subcommittee determined that the operational requirements of these "Other" services must be included in its catalog, because their activities occasionally or frequently, depending on the entity, will intersect with actitities of traditional public safety entities, or otherwise impact public safety. The Subcommittee created this working groups to outline the needs of these "Other" public safety entities. For purposes of this workgroup report, the specific "Other" groups are Local Government, Mass Transportation, Forestry Conservation, and Highway Maintenance, and they are defined as follows.

These definitions reflect the function of a service as viewed by this subcommittee for a report and not its eligibility for spectrum licensing.

Local Government Communications: Any United States territory, possession, state, county, city, town/village, or similar governmental entity, including a district and an authority. The need is for essential communications for official governmental activities.

Mass Transportation Communications: Organizations operating a transportation system which on a regular basis transports passengers. These organizations have the responsibility for the safety and general welfare of the passengers during transportation. The need for communications is based on safety and operations of the system.

Forestry-Conservation Communications: Organizations charged with specific

forestry and conservation activities that conserve, improve, and protect natural resources and environment. Major activities include enforcement of environmental conservation laws; maintenance of air & water quality; hazardous, toxic, and solid waste management; mined land reclamation; wetland protection; environmental impact analysis; pesticide use regulation; fish & wildlife management; stream protection; park & primitive area management; and forestry. Communications needs are based on the performance of official duties.

Highway Maintenance Communications: Organizations charged with specific highway maintenance activities. Activities include maintenance of roads, highways, tunnels, bridges required to allow safe thoroughfare of the general public. Communications needs are based on official duties.

Comments Received from User and Constituent Entities. This working group devoted substantial energy to encouragement of user participation. In order to provide a background for the operational requirements the working group identified, the following summary of the principal responders and their activities is included.

City of New York Department of Information Technology & Telecommunications (NYCDoITT). NYC DoITT's mission is to expand, enhance, and maintain the City's information technology infrastructure to facilitate agency operations and provide public access to government services. NYCDoITT serves the Mayoral agencies of the City of New York.

New York City Government consists of the Office of the Mayor that has several suboffices. There are deputy mayors for specific responsibilities. There are many other mayoral offices that focus on legislative, community, and general matters all of which are a function of government. The City of New York has many individual departments that fall under the Local Government Communications Service ranging from the Department of Aging, through the alphabet, to the Department of Youth Services. Also under NYCDoITT's technology jurisdiction fall some emergency responder agencies that are not included within this workgroup report. The information represented here satisfies the needs of the City of New York as a local governmental entity.

Metropolitan Transportation Authority - New York City Transit (MTA-NYCT). In 1968, the New York State Legislature created the Metropolitan Transportation Authority (MTA) to oversee transportation in 12 counties of the New York City metropolitan area. The Metropolitan Transportation Authority is a New York State entity that is the coordinating body of the transit agencies listed below:

- MTA New York City Transit
- MTA Metro-North Railroad
- MTA Bridges and Tunnels
- MTA Long Island Railroad
- MTA Long Island Bus
- MTA Card Company

The MTA agencies provide subway, bus, and commuter rail service to millions of residents, commuters and visitors in addition to operating seven bridges and two tunnels. Without them New York City could not be the center of finance, commerce, culture, and entertainment that it is today.

MTA-NYCT operates every day, 24 hours a day and provides essential public

transportation service to the five boroughs of New York City. MTA-NYCT has the largest rapid transit system and the largest bus transit system in the nation. On an average weekday, the subway serves 3.6 million passengers and buses serve 1.5 million customers. Ridership (1.1 billion rides per year) ranks MTA-NYCT as sixth in the world, but the number of actual subway cars ranks the MTA-NYCT as the largest fleet in the world. MTA-NYCT's workforce consists of approximately 44,000 employees who support the transportation system. MTA-NYCT's efforts are focused on the more than 5 million customers who travel with them every weekday by subway trains and buses. Its passengers are entitled to a safe, orderly, crime free, comfortable and convenient ride. MTA-NYCT continues to orient and revise its services to meet passenger needs and to provide a safe public transportation system. The MTA-NYCT is a local governmental entity providing mass transportation services and submits its Operational Requirements under the category of Mass Transportation.

4.6.3 **Operational Needs.** The working group identified the following operational needs as typical of each of the "other" entities indicated.

Local Government

- Two-Way Voice Communications
- Telephone System Access
- Vehicle Location Tracking
- Portable Location Tracking
- Two-Way Mobile and Portable Data Terminals
- One-Way Data Transmission
- Paging
- Variable Information Distribution for Public Safety/Service
- One-Way Video
- Two-Way Portable Video

Mass Transportation

- Two-Way Voice Communications
- Limited Telephone System Access
- Vehicle Location Tracking
- Portable Location Tracking
- Two-Way Mobile and Portable Data Terminals
- One-Way Data Transmission
- Paging
- Variable Information Distribution for Schedule and Information Signs
- One-Way Video
- Wireless Voice Public Address

Forestry-Conservation

- Two-Way Voice Communications
- Limited Telephone System Access
- Vehicle Location Tracking
- Portable Location Tracking
- Two-Way Mobile and Portable Data Terminals

Highway Maintenance

- Two-Way Voice Communications

- Limited Telephone System Access
- Vehicle Location Tracking
- Portable Location Tracking
- Two-Way Mobile and Portable Data Terminals
- Variable Information Distribution via Roadway Signs
- One-Way Video

4.6.4 **Descriptions of each Typical Operational Requirement.**

Two-Way Voice Communications. Voice communications from dispatcher control points to field units; field units to multiple field units; or individual to individual through either mobile mounted or hand held portable radios.

Telephone System Access: Mobile mounted or hand held portable radios which have system access to the public switched telephone network.

Vehicle Location Tracking: Ability of dispatcher control points or other vehicles to monitor apparatus locations within the geographical service area.

Portable Location Tracking: Ability of dispatcher control points or other field units to monitor individual locations of a hand held portable radio user within the geographical service area.

Two-Way Mobile and Portable Data Terminals: Field computers capable of remotely accessing information systems and files. May be used for dispatch or field support to perform real time changes to system data. Equipment may be vehicle mounted or as a hand held portable unit.

One-Way Data Transmission: Telemetry or real time information transfer from field locations (fixed, mobile, or portable) to fixed control points. Transmission is used to monitor the functions of a system, site, or device.

Paging: One way signaling device used to alert vehicles or persons and transmit limited alphanumeric messages.

Variable Information Distribution: Ability of the authorized entity to dynamically change visible street signs/bulletin boards etc.. to alert the public of potential hazards or delays.

One-Way Video: Ability to remotely view specific locations or interests through either snapshot or real time video as necessary.

Two-Way Portable Video: Ability of field units and dispatch control points to communicate using real time video with voice from mobile or hand held portable radios.

Wireless Voice Public Address: Ability of the authorized entity to announce relevant safety information to the general public. Access is provided through a fixed dispatch point or authorized mobile/portable radio unit.

5.0 CURRENT SHORTFALLS

The mission of the Subcommittee included identifying operational requirements that currently are unmet or suffer from reliability, quality or coverage deficiencies. Shortfalls of this nature were identified by virtually every working group, but in general they can be categorized as indicated in the following discussion.

Foreign Frequency Interference. Public safety entities operating along United States borders with Mexico are experiencing interference from communications devices and services located outside the United States. For example, business communications from Mexico are occurring on VHF and UHF public safety frequencies. Coordination with Mexico or other decisive action is necessary to ensure that whatever frequencies are allocated for public safety use in the United States remain free from foreign frequency interference.

Insufficient Channels. A general observation of virtually all participants in the Subcommittee's work was that the existing allocation scheme does not provide sufficient channels to support existing operations, let alone the future needs indentified by the various working groups. Although this shortfall is universally understood and a major portion of the rationale for formation of the Advisory Committee, the Subcommittee deemed it appropriate highlight the urgency created by the shortfall that already exists.

Coverage Inside Buildings. Present standards in the 800 MHZ spectrum limit signal strength to 40dBu at service area boundaries. This strength frequently is not sufficient to support building penetration near service area boundaries. Standards for channel use in adjacent service areas must allow sufficient signal strength to achieve building penetration throughout a user entity' entire service area.

Multi-Path Interference. Voice communication problems created by multi-path inteference must be resolved to provide clear voice communications in areas affected by multi-path interference.

6.0 INTEROPERABILITY ISSUES

Inter-agency communications between federal, state, county, township and local police, fire, and EMS units is necessary. Coordination at natural and man-made disasters require close communications for deployment of scarce resources during incident management by the police, fire and EMS units responding to the event.

In addition, the ability to communicate among and between the various public safety units must also be broken out by geographic area yet respecting the ability to "look-back" or monitor the chain of command of the several organizations. In other words, at the site of a wide area incident various police and fire units responding should be able to monitor selected channels or talk groups within their organizational structure, but also have the ability to speak across organizational lines (police to fire, fire to EMS, etc.) to coordinate activities at a given geographic location up to several miles wide.

Inter-operability across organizational group by rank or responsibility: The officer in charge of comparable responsibility from each of the respective police jurisdictions should have the ability to speak directly with each other in a secure or uninterrupted channel or talk group over the portable radio to deploy the necessary resources where they are most needed.

ANNEXES

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B - WORKING GROUP REQUIREMENTS MATRICES
C - SUBCOMMITTEE MEMBERSHIP

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